

DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION

Improvements relating to Fluorescent Lamps.

We, DURO-TEST CORPORATION, 2321 Hudson Boulevard, North Bergen, New Jersey, United States of America, a corporation of the State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

Fluorescent lamps have been designed to operate with optimum results depending on the type of ballast circuit with which the lamps are to function. This was especially true during the earlier days of the art when preheat lamps were designed only for use with preheat ballast circuitry without compromise for use with any other ballast circuit. Later in the art, the rapid start lamp was designed for use only with rapid start ballast circuitry without compromise for use with any other circuit. More recently, and commonly the practice of most fluorescent manufacturers, the rapid start lamp has been compromised to operate in both rapid start and preheat ballast circuits without any apparent change in the fundamental lamp design. It is common knowledge in the art, however, that sacrifices in efficiency result from the compromise depending on the circuit in which the rapid start lamp is used; the lamp operating with least efficiency in preheat circuits. It is an object of this invention to obviate or mitigate this disadvantage.

The present invention provides a fluorescent lamp operable from a source of voltage, including a sealed envelope and a pair of cathodes, each of which has an electron emissive coating thereon, mounted at each end of said envelope to have an included angle of substantially less than 180° therebetween. The two cathodes of each pair are in an opposing relationship so that the first

cathode of each pair receives electron emissive material from the second cathode of the pair as the second cathode maintains the arc discharge thereon. A pair of leads are connected to the terminals of the first cathode at each end of the envelope and these leads are each connected to a respective terminal of the voltage source for supplying heating current to and an arc discharge potential across the terminals of the first cathode of each cathode pair to initiate and maintain an arc discharge between the first cathode of each pair until a said first cathode is substantially exhausted of emissive material. One terminal of the second cathode of each cathode pair is connected to only one of the leads of a respective pair of leads to receive only the arc discharge potential so that the arc will still be maintained between the second cathode of each cathode pair. When operating, the second cathode of each pair supplies electron emissive material to the first cathode of its pair when the first cathode is substantially exhausted of emissive material so that the first cathode of a pair can subsequently act as a starter electrode to initiate the discharge.

For the purpose of illustration embodiments of the invention are shown in the accompanying drawings in which:

Fig. 1 is an isometric side view of a cathode structure;

Fig. 2 is a top view of a cathode structure;

Fig. 3 diagrammatically illustrates a circuit arrangement for rapid start fluorescent lamps employing the cathode structure of this invention;

Fig. 4 is a similar diagrammatic circuit illustration of a preheat circuit for fluorescent lamps employing the cathode structure of this invention;

Fig. 5 is a view similar to Fig. 3, showing a

modified connection for the double cathodes; and

Fig. 6 is a view similar to Fig. 4 showing a modified circuit connection for the double cathodes.

In Fig. 1, the cathode structure is shown mounted in a glass stem press 22 and flare assembly 8 which is provided to seal the end of an elongated fluorescent lamp envelope.

The assembly 8 includes the exhaust tube 6 and the aperture 10 providing the means for processing the fluorescent lamp envelope towards finished assembly. Lead-in wires 12, 14 and 16 pass through assembly 8 and are spaced in the stem press 22 to provide equal distance between lead-in wires 12 and 16; 14 and 16. Stem press 22 is especially configured, as shown in Fig. 1 and Fig. 2, to support the dual purpose cathode structure.

The included angle formed by main and auxiliary cathodes 20 and 18 is specified as 40—45° for optimum results. It is pointed out, however, that the included angle between the cathodes of a pair is not critical, the primary condition being that barium will be deposited on the starting (main) electrode at the time when the adjacent (auxiliary) electrode is functioning as the operating electrode. The purpose of this is to keep the starting electrode supplied with a sufficient quantity of emissive material to establish the initial arc. The plane of the cathode structure, with reference to the axis of the fluorescent lamp envelope, may be perpendicular as shown, but need not be. Cathodes 18 and 20 used in the dual structure utilize a multi-turn overwound design with parameters commonly employed by the industry for preheat-rapid start fluorescent lamps.

In the processing of the fluorescent lamp envelope with a sealed-in member 8 at each end, lead-in wires 12 and 14 provide the means for activating the cathodes 18 and 20 coated with the usual alkaline earth metals common to the art. Either pair of lead-in wires 12 and 16 or 14 and 16 may be used to provide the electrical connections to the lamp base contact pins. The remaining lead-in wire 12 or 14, whichever is not selected for the electrical connection, may be either short circuited to lead-in wire 16 or cut from the assembly 8.

In the embodiment of the invention illustrated in Figures 3 and 4, the lead-in wire 12 or 14, in the case illustrated the lead-in wire 14, cut off short and left unconnected to the circuit.

On the other hand, the embodiment of Figures 5 and 6 show the modified arrangement wherein the lead-in wire 12 or 14, in the case illustrated the lead-in wire 14, is connected to the lead-in wire 16. In other words, the cathode 18 is short circuited.

The cathodes 18 and 20 of each pair preferably have substantially the same physical

and electrical characteristics. They can take any of the physical forms which filamentary cathodes for fluorescent lamps commonly take, including coiled and coiled coil or triple coiled arrangements. They will be coated with the usual electron emissive coatings well known in this art, such as the usual alkaline earth oxides, including, if desired, the usual quantity of zirconium oxides. The inert gas fillings for the envelope will be those usually employed including neon, krypton and the like, as well as mixtures thereof, all as is well understood in this art. The lamp envelope, diagrammatically illustrated in Figures 3 to 6 inclusive at 24, will have the usual phosphor coating 26, which is normally placed on the inner wall of the tube as indicated. In the circuits of Figures 5 and 6, wherein the cathodes 18 are shorted upon themselves, the chief advantage of this variation is that during the latter stages of the lighting of the lamp there will be less wattage dissipation by reason of conduction through the cathode 18 itself than is the case shown in Figures 3 and 4 where the corresponding lead 14 of this cathode is disconnected.

During the operation of a fluorescent lamp utilizing the dual purpose cathode structure the starting of the lamp is initiated by applying filament heating current to the main cathodes which are electrically connected across the contact pins of the lamp bases. This cathode will operate as both the starting electrode and operating electrode until an interval in life when its emitting properties cease to function as an operating electrode but remain adequate as a starting electrode. At this interval the adjacent auxiliary cathode serves as the operating electrode.

It may be helpful to note that during the exhaust cycle the pairs of cathodes of both embodiments of these lamps are treated out in series by passing currents through leads 12 and 14. In the initial operation of the completed lamp, the main cathodes 20, with the lamp connected in either rapid start or preheat ballast circuits, are energized with the heating current in the usual way. The cathodes 20 have the ballast potential thereacross so that they strike an arc and act as the operating cathode until they are completely stripped of emissive material. At this stage of the life of the lamp the lamps will still be started by heating the cathodes 20, but during operation the arc will shift to the auxiliary cathodes 18 with the ballast transformer potential still across the electrodes 20 which are connected to the electrodes 18 in the arc stream completing the electrical circuit therebetween. In this mode of operation, some emission material will be evaporated or sputtered off and condensed on the cathodes 20 during operation. When the lamp is restarted it will again begin operation by the striking of the arc between the cathodes 20 by reason of the thin

film of emission material previously received. Almost immediately, however, after starting the arc discharge will transfer to the cathodes 18 and this operation will be repeated until all the emission material is stripped from the cathodes 18, signalling the end of the life of the lamp.

WHAT WE CLAIM IS:—

1. A fluorescent lamp operable from a source of voltage, including a sealed envelope and a pair of cathodes, each of which has an electron emissive coating thereon, mounted at each end of said envelope to have an included angle of substantially less than 180° therebetween, the two cathodes of each pair being in an opposing relationship so that the first cathode of each pair receives electron emissive material from the second cathode of a pair as said second cathode maintains the arc discharge thereon, a pair of leads at each end of said envelope, the first lead of each pair connected to one terminal of a respective first cathode of a cathode pair and to one terminal of a second cathode of the cathode pair, the second lead of each pair of leads connected to the other terminal of the first cathode of a cathode pair, means for connecting each pair of said leads to respective terminals of the voltage source for supplying heating current to and an arc discharge potential across the terminals of said first cathode of each cathode pair to initiate and maintain an arc discharge between said first cathode of each pair until said first cathode is substantially exhausted of emissive material, said first lead of a respective pair of leads supplying only the arc discharge potential to the second cathode of each pair so that the arc will still be maintained by the second cathode of each cathode pair, said second cathode upon operation supplying electron emissive material to said first cathode of its pair when said first cathode is substantially exhausted of emissive material so that said first cathode can subsequently act as a starter electrode to initiate the discharge.

2. A fluorescent lamp according to claim 1 including means for permanently keeping the other terminal of each of said second cathodes out of electrical contact with all other conductive components of the lamp.

3. A fluorescent lamp according to claim 2, further comprising a stem press of electrical insulating material for each end of the lamp having first, second and third support wires thereon, said first cathode of each

cathode pair mounted between said first and second support wires of a respective stem press, which two support wires also form the pair of leads, the second cathode of a pair being connected between said second support wire and one end of the third support wire, the other end of said third support wire terminating interior of its respective lamp end and being held in the stem press in an electrically insulating position.

4. A fluorescent lamp according to claim 1, including means for permanently electrically connecting the two terminals of each said second cathode of each pair together.

5. A fluorescent lamp according to claim 4, further comprising a stem press of electrical insulating material having first, second and third support wires thereon, said first cathode of each cathode pair mounted between the first and second support wires of a respective stem press which two support wires also form the pair of leads, the second cathode of a pair mounted between the second and third support wires, and an electrical connection between said second and third support wires.

6. A fluorescent lamp according to any preceding claim, wherein the included angle is in the range of 40° to 45° .

7. A fluorescent lamp according to any preceding claim, wherein the cathodes of each pair are located in a plane perpendicular to the longitudinal axis of the envelope.

8. A fluorescent lamp according to any one of the preceding claims, wherein the cathodes of each pair are physically and electrically substantial equivalents.

9. A fluorescent lamp according to any one of the preceding claims wherein the source of voltage comprises either a rapid start or a preheat ballast circuit.

10. A fluorescent lamp substantially as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawings.

11. A fluorescent lamp substantially as hereinbefore described with reference to Figures 1, 2, 5 and 6 of the accompanying drawings.

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FIG. 1

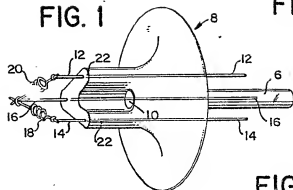


FIG.

FIG. 2

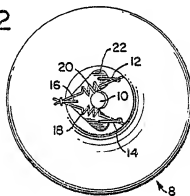
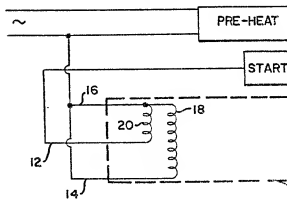


FIG. 4



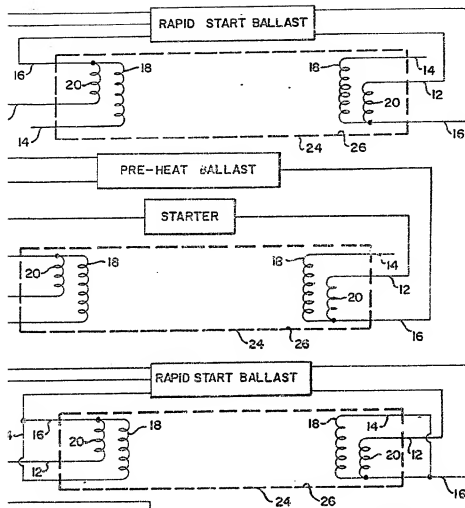


FIG. 5

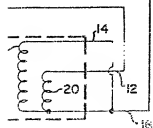


FIG. 6

